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# NASA TECH BRIEF



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## Reinforcement of Polymeric Structures with Asbestos Fibrils

An experimental investigation was conducted to determine the structural potential of chrysotile asbestos fibrils, which have found wide use as reinforcements in various plastic matrixes; and to develop methods for dispersing macrofibers of the asbestos into colloidal-sized (200 to 500 Å) ultimate fibrils (abbreviated UAF) and for incorporating the UAF in matrixes without causing reagglomeration. Attempts to develop methods for producing UAF were undertaken because it was found that the tensile strength of conventional macroscopic asbestos fibers (abbreviated MF) increases as fiber diameter decreases. Fine-diameter MF, in the range of 10 to 20 $\mu$  (10<sup>5</sup> to 2  $\times$  10<sup>5</sup> Å), have tensile strengths which have been reported to be as high as 824,000 psi (U.S. Pat. 2,626,213). It is therefore reasonable to assume that 0.02 $\mu$  (200 Å) UAF could have strengths greater than 1,000,000 psi. A commercial method of producing asbestos fibrils (based on U.S. Pat. 2,626,213) for use as reinforcements in plastics composites yields a mixture of UAF and MF. In that method, the UAF-MF fibrils are produced by slow-speed stirring of a suspension of MF in a water solution of a suitable surfactant.

One of the results of the investigation was the development of an improved method for producing colloidal dispersions of asbestos in a water solution of any one of several commercially available surfactants (phosphate esters, for example). In this method, 100% UAF dispersions are obtained by high-speed shear-mixing of AY grade asbestos in aqueous surfactant solutions (in a commercial household blender, for example) for about 1-1/2 hours. The recovery of UAF, or UAF-MF, from the dispersing medium is accomplished by either one of two techniques. In the first technique, the dispersion is filtered

to remove the larger fibers, and the filtrate containing the colloidal UAF is coagulated by adding water (or alcohol). The supernatant water is removed by filtration and the resultant mat or paper of UAF is dried. These papers were found to contain a high percentage of adsorbed surfactant. In the second technique, the UAF is recovered by evaporation of the water. In this case, the percentage of surfactant retained by the UAF is even higher. To provide for the preparation of solid, void-free composites of high densities, the dried paper obtained by either technique is pressed at 400 to 1000 psi. The densified paper may then be vacuum-impregnated with any one of a variety of resins. It was found that the surfactant adsorbed on the asbestos fibrils affects the ultimate bonding of the asbestos to the matrix in the composites prepared. In general, high proportions of residual surfactant tend to reduce the strength of asbestos/phenolic and asbestos/polyester composites. The papers containing 33% or more surfactant are remarkably strong (tensile strengths range from 820 to 6100 psi) compared to papers with lower surfactant content (tensile strength of approximately 100 psi), before phenolic resin impregnation. In these papers, the surfactant may be acting as a lubricant, preventing the asbestos fibrils from cutting each other when placed under tension. When these papers containing 33% surfactant are impregnated with phenolic resin, the tensile strengths range from 4600 to 5200 psi depending on the composition of the surfactant used. However, the surfactant apparently interferes with resin/asbestos bonding. As expected, by orienting the asbestos reinforcement, an increase in strength (over isotropic reinforcement) was obtained in the direction of orientation. Partially oriented arrays of UAF were prepared by slowly drawing filaments of UAF from a

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water-diluted dispersion of UAF in an aqueous surfactant solution. When impregnated with phenolic resin, the arrays had tensile strengths up to 100,000 psi. UAF was thus found to be at least as strong as MF, although anticipated strength advantage over MF was not demonstrated.

In the second and improved method the UAF dispersions are prepared simply by mixing macrosized asbestos fibers with any one of several organic liquids in the same type of high-speed blender used for the water-surfactant dispersions. The following are among the organic liquids which were found to serve as effective dispersants for the asbestos: ethylene glycol, mono-, di-, and tri-ethanolamine, glycerol, polyethylene glycol, polypropylene glycol, undecylenic acid, lauric diethanolamide, mineral oil, and linoleic acid. This method of producing UAF offers the following advantages:

- (1) The colloidal asbestos fibrils can be readily recovered free of adsorbed contaminants by evaporation of volatile dispersing media.
- (2) Selected dispersing liquids can serve as solvents for a matrix resin, thus allowing intimate mixing of the resin with UAF in the stage before the solvent is removed to produce an asbestos-reinforced resin.
- (3) Certain dispersing liquids can serve either as precursors of a matrix resin or as one of the components of a matrix resin, thus obviating the need to evaporate a solvent.

This method of producing colloidal asbestos dispersions in organic media should be particularly useful in the preparation of asbestos-reinforced plastics and elastomers; special lubricants; solvent-carried paints, varnishes, and adhesives; and in paper, film, and foil coatings where the fibrils must be free of surface contaminants.

**Note:**

The following documentation may be obtained from:

Clearinghouse for Federal Scientific  
and Technical Information  
Springfield, Virginia 22151  
Single document price \$3.00  
(or microfiche \$0.65)

**References:**

NASA-CR-893 (N67-36014), Colloidal  
Asbestos Fibrils As Reinforcements for  
Polymeric Structures

NASA-CR-77225 (N66-34670), The Rein-  
forcement of Polymeric Structures by  
Asbestos Fibrils

**Patent status:**

No patent action is contemplated by NASA.

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